

Application No.: 10/669,616
Amendment dated May 9, 2006
Reply to Office Action of December 9, 2005

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims

1. (currently amended) A method for removing a material covering an alignment mark on a substrate, comprising:

mounting the substrate onto a stage in a focused ion beam system, said focused ion beam system having a non-liquid metal ion source;

directing an ion beam at the material covering an alignment mark, said ion beam having a beam current greater than 300 nanoamps and directed at an oblique angle relative to the surface of the substrate; and

removing said material by ion beam sputtering, said ion beam maintaining a substantially identical oblique angle relative to the surface of the substrate while material is removed by ion beam sputtering.

2. (original) The method of claim 1 in which the focused ion beam system has a plasma ion source.

3. (original) The method of claim 1 in which the ion beam is directed at an angle less than 80° relative to the substrate surface normal.

4. cancelled

5. cancelled.

6. (currently amended) A method for removing a material covering an alignment mark on a substrate, comprising:

directing a ~~The method of claim 5 in which said focused ion beam is a beam of noble gas ions at the material covering an alignment mark;~~

Application No.: 10/669,616
Amendment dated May 9, 2006
Reply to Office Action of December 9, 2005

said focused ion beam being directed at the substrate at an angle of between 40° and 80°
relative to the substrate surface normal; and
removing said material by charged particle beam sputtering without using an etch
assisting gas.

7. (currently amended) The method of claim 6~~5~~ in which said focused ion beam is selected from the group consisting of an argon ion beam, a krypton ion beam, and a xenon ion beam.

8. cancelled

9. cancelled

10. (currently amended) The method of claim 6~~claim 4~~ in which the charged particle beam has a beam current of 300 nanoamps to 20,000 nanoamps.

11. (currently amended) The method of claim 6~~claim 4~~ in which the charged particle beam has a beam current of 1500 nanoamps to 5000 nanoamps.

12. (currently amended) The method of claim 6~~claim 4~~ in which the substrate is a silicon wafer.

13. (currently amended) The method of claim 6~~claim 4~~ in which the material covering an alignment mark is a metal film.

14. (currently amended) An apparatus for removing a material covering an alignment mark on a substrate, comprising:

a device to load the substrate;

a device to align the substrate;

a device to position the substrate;

a noble gas ion beam system~~charged particle beam system~~ having a noble gas ion
~~charged particle~~ source suitable for emitting a noble gas ion beam~~charged particle beam~~, said

Application No.: 10/669,616
Amendment dated May 9, 2006
Reply to Office Action of December 9, 2005

source oriented at an oblique angle relative to the substrate surface normal, an optical system to focus the noble gas ion beam~~charged particle beam~~, and a computer controlled beam deflector to position the noble gas ion beam~~charged particle beam~~;

a device for controlling the charged particle beam dose applied to said material;

computer accessible memory in communication with said device to position the substrate and said device to control the charged particle beam dose applied to said material, the memory storing computer instructions for:

(i) directing a charged particle beam at material covering an alignment mark; and

(ii) removing said material by charged particle beam sputtering ~~without using an etch assisting gas~~; and

a device to unload the substrate.

15. cancelled.

16. cancelled

17. (original) The apparatus of claim 14 in which the charged particle beam system is selected from the group consisting of an argon ion beam system, a krypton ion beam system, and a xenon ion beam system.

18. cancelled.

19. (original) The apparatus of claim 14 in which the charged particle beam is directed at an angle of between 40° and 80° relative to the substrate surface normal.

20. (original) The apparatus of claim 14 in which the charged particle beam has a beam current of 300 nanoamps to 20,000 nanoamps.

21. (original) The apparatus of claim 14 in which the charged particle beam has a beam current of 1500 nanoamps to 5000 nanoamps.

Application No.: 10/669,616
Amendment dated May 9, 2006
Reply to Office Action of December 9, 2005

22. (original) The apparatus of claim 14 in which the device for aligning the substrate comprises an optical microscope.

23. cancelled

24. (previously presented) A method for removing a material covering an alignment mark on a substrate, comprising:

mounting the substrate onto a stage in a focused ion beam system, said focused ion beam system having an ion column with an optical axis and a non-liquid metal ion source;

directing an ion beam at the material covering an alignment mark, said ion beam having a beam current greater than 300 nanoamps and said optical axis forming an oblique angle relative to the substrate surface normal; and

removing said material by ion beam sputtering without using an etch assisting gas.

25. (new) The method of claim 24 in which the charged particle beam has a beam current of 300 nanoamps to 20,000 nanoamps.

26. (new) The method of claim 24 in which the charged particle beam has a beam current of 1500 nanoamps to 5000 nanoamps.

27. (new) The method of claim 24 in which the substrate is a silicon wafer.

28. (new) The method of claim 24 in which the material covering an alignment mark is a metal film.

29. (new) The method of claim 24 in which said focused ion beam is an argon ion beam.

30. (new) The method of claim 6 in which said focused ion beam is an argon ion beam.